CHAPTER 16

Inflation and Output Fluctuations

In Chapter 9 we examined macroeconomic policy, focusing on the impact of onetime changes in government spending and the money supply on the economy. Our detailed study of consumption, investment, international trade, government, the monetary system, and the behavior of prices in the ensuing six chapters has paved the way for a more thorough examination of economic policy. In this chapter we expand the framework for policy analysis of Chapter 9 to include more realistic descriptions of price adjustment, lags, and expectations. We also incorporate the modern idea of policy rules explicitly into the framework. In the final two chapters we use this expanded framework for an assessment and evaluation of macroeconomic policy in the United States and other countries.

16.1 PRICE ADJUSTMENT

Our basic theory of price adjustment indicates that inflation rises when demand conditions are tight, when expectations of inflation rise, or when there are price shocks. A simple algebraic summary of this theory can be written as follows:

$$\pi = \underbrace{f\hat{Y}_{-1}}_{\substack{\text{Market}\\ \text{conditions}\\ \text{(slack or}\\ \text{tight)}}} + \underbrace{\pi^{e}}_{\substack{\text{Expecta-}\\ \text{tions of}\\ \text{inflation}}} + \underbrace{Z}_{\substack{\text{Price}\\ \text{shocks}}}. \tag{16.1}$$

Here $\hat{Y}_{-1} = (Y_{-1} - Y^*)/Y^*$, the percentage deviation of real GDP from potential GDP. The subscript -1 indicates that current inflation is related to market pressure in the previous period, reflecting the lags in price and wage adjustment. The last term, Z, representing price shocks, describes the upward or downward effect of a change in world oil prices or other factors that affect inflation through channels other than market conditions or expectations. In most years Z is close to zero, but occasionally sharp movements in oil, grain, or other markets create noticeable shocks in the process of inflation.

One of the most important properties of Equation 16.1 is that there is no long-run trade-off between inflation and the level of GDP. A country with a high average inflation rate will not have any higher output than a country with a low inflation rate that is generally expected to continue. That there is no trade-off follows from Equation 16.1: on average, the effect of price shocks will be zero ($Z = 0$), and expected inflation π^e will equal actual inflation π in the long run regardless of the level of actual inflation. Hence, according to Equation 16.1, the market conditions term $\hat{Y}_{-1}$ equals zero, or, equivalently, actual output equals potential output. The proposition that there is no long-run trade-off between output and inflation is sometimes called the *natural-rate property* because the unemployment rate is equal to the natural rate regardless of the rate of inflation; it is also sometimes called the **accelerationist property** because attempts to keep output above normal result in accelerating prices.

The theories of price rigidity discussed in Chapter 15 indicate that there are several alternative interpretations of Equation 16.1. For example, both the imperfect information theory (Section 15.1) and the staggered-wage-setting model (Section 15.3) can explain the positive relationship between the rate of change in prices and real GDP in Equation 16.1. This equation is an approximation which explains the basic facts of inflation and which is consistent with these theories, but in using it for policy we must be careful how we interpret the coefficients. In particular, the sensitivity of inflation to recent market conditions (f) is likely to change when the economic environment changes. Here we consider three important examples of changes in the economic environment: an increase in the amount of indexing, a reduction in the average size and length of business cycles, and changes in the average rate of inflation.

The Effect of Wage Indexing

As we saw in Chapter 15, there is some indexing in the United States of union labor contracts (cost-of-living adjustment provisions). Indexing is more prevalent in other countries; a good example is Italy. With indexing, each time the price level rises by 1 percent, wages rise by a fraction of a percent a, automatically. The indexing coefficient is greater than zero and can be as high as 1. How would indexing affect the price adjustment relationship? Indexing means that the wage will respond to the current rate of inflation as well as to the lagged rate of inflation. The effect of this is to speed up the overall response f of inflation to changes in unemployment. To see this, suppose there is an increase in output that initially increases wage inflation by 1 percent. This will quickly have an upward influence of 1 percent on prices. But if wages are indexed, the upward adjustment of price inflation will mean a further upward adjustment of wage inflation of the amount a. This in turn will increase price inflation by a, through the markup process. Again indexing will raise wage inflation, now by an amount a times a, or a^2. And the process will continue for a third round, where inflation will increase by another multiple of a (a^3). The whole process is called a **wage-price spiral.** As long as indexing is less than 100 percent (that is, as long as $a < 1$), the process will eventually settle down, but the end result has been to make wages adjust more to the increase in output than if there had not been any indexing. The total effect is

$$1 + a + a^2 + a^3 + \cdots = \frac{1}{1 - a}$$

using the formula for the geometric series. Note that the total effect is much like the formula for the multiplier. For example, if a equals .5, then the effect of market conditions on inflation is doubled: $1/(1 - .5) = 2$. In general, indexing makes inflation more responsive to market conditions, as represented by a higher value for the coefficient f in Equation 16.1.

For the same reasons, indexing also increases the response of inflation to price shocks Z. When the cost of materials rises, firms increase their prices. But because of indexing, this price increase will raise wages. In turn, the increase in wages increases prices again. The wage-price spiral thus multiplies the effect of a raw materials price on inflation. If there is no indexing, so that the wage does not respond at all to prices, other costs will go directly into prices with a coefficient of 1. But because wages rise when prices rise, there is a feedback effect—the wage-price spiral. The feedback effect can more than double the impact of a price shock

Length and Severity of Business Cycles

In Chapter 15 we looked at the implications of forward-looking behavior: Workers and firms look ahead to future labor market conditions and to price and wage inflation. If workers expect a recession to be short, then they will be more reluctant to accept lower wages than if they expect the recession to last for a number of years. In the price adjustment equation, the market conditions term $\hat{Y}_{-1}$ not only represents current conditions but also stands in for future excess supply or demand. Usually business cycles last for a number of years, so if output is below potential this year, that is an indication that output will probably be below normal for a few more years.

But suppose that departures of output from potential become less persistent; for example, suppose that the average length of business cycles is reduced from four to two years. Then if GDP is below potential today, there is no implication that GDP will be below potential two years from now. The best guess is that GDP will be back to potential two years from now. As a result inflation will be less responsive to recessions. Algebraically, the coefficient f in Equation 16.1 will be smaller when recessions are expected to be less prolonged.

Models of the Expected Inflation Term

One of the most difficult issues in the price adjustment equation is how to determine the measure of expected inflation π^e. There are two important factors to consider.

1. ***Forward-looking forecasts***

The expectation that prices and other wages will rise in the future influences the process of wage setting between the worker and the employer and the wage that emerges from it. The amount of inflation that is forecast to occur in the future is therefore part of the expected inflation term. If workers and unions are informed about the economy, these forward-looking forecasts will match rational expectations theory.

2. ***Staggered contracts and backward-looking wage behavior.***

The influence of today's expectations on the expected inflation term is only part of the story, however. Because of wage contracts and staggered wage-setting, the expectations term involves inertia that cannot be changed overnight. Workers and firms take account of the wages that will be paid to other workers in the economy. Since wage setting is staggered over time, some wages are set by looking back at the previous wage decisions of other workers; once these wages are set, they are not changed during the contract period unless economic conditions change drastically. Wage inflation has a momentum due to contracts and relative wage-setting. The expectations term must take account of this momentum as well as of the pure expectational influence.

Our description of expected inflation must be consistent with the actual behavior of inflation as observed over a number of years. If inflation typically tends to have momentum, then the public's model of expected inflation will also have momentum. But if inflation tends to be temporary, because of a policy to stabilize prices, for example, then people's view of expected inflation will incorporate the belief that a burst of inflation will probably not be followed by continued inflation.

For the above reasons, any model of expected inflation is itself endogenous to the type of economy or type of policy that is in operation. If policy changes, the model of expected inflation should change.[1] For example, if the Fed announces that it is switching to a new policy that puts more weight on controlling inflation and the public believes it, the model of expected inflation will change. If, on the other hand, people are highly skeptical about promised changes in government programs, then it may take an actual change in inflation to convince them that expected inflation has changed. In that case, a simple backward-looking model of the expected inflation term is closer to the truth—at least for the period of time that it takes the government to convince people that it means business.

The simplest model says that this year's expected inflation depends on actual inflation last year:

$$\pi^e = \pi_{-1}. \tag{16.2}$$

This description of expected inflation is far from satisfactory, however. Suppose monetary policy tried to keep GDP above potential GDP ($Y > Y^*$) year after year. Because of the lag in forming expected inflation, it appears that this policy would be feasible, although it would mean that inflation would rise each year. In reality, a policy that increased inflation each year would not keep output above potential indefinitely. Eventually the public would catch on and build the steady increase in inflation into its expectations of inflation. Then actual and expected inflation would be equal, and, from Equation 16.1, output would be at potential, not above.

We could look at more complicated models of expected inflation that try to keep up with the rate of change of inflation as well as its level, but the main ideas should already be clear. There is a very general point at work here: *No mechanical model of expected inflation is universally applicable.* If the public has a particular way of arriving at expected inflation, the government can design a policy that fools the public and makes actual inflation continually exceed expected inflation. But then the public will revise its method of calculating expected inflation so that it will no longer be fooled.

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[1] Robert Lucas made this point forcefully in his critique of macroeconomic models as they existed in the early 1970s. He pointed out that these models failed to consider that rational individuals would change their behavior when policy rules change. Fixed models of expected inflation in the Phillips curves were a particular target of his criticism. See Robert Lucas, "Econometric Policy Evaluation: A Critique," in Karl Brunner and Allan Meltzer, eds., *The Phillips Curve and Labor Markets*, Carnegie-Rochester Conference Series on Public Policy, Vol. 1 (Amsterdam: North-Holland, 1976), pp. 19–46.

If the government uses a policy that does not attempt to fool the public by making actual inflation exceed expected inflation, then there can be a stable way that the public arrives at expected inflation. In particular, if the government aims at a steady inflation rate and acts to offset occasional bursts of inflation from materials prices and elsewhere, then our simple model of expected inflation is a reasonable description of the process.

A policy that attempts to keep output above normal permanently will fail. Eventually the public will catch on to the policy and revise expected inflation by a method that makes it keep up with actual inflation.

A Graphical Representation of Price Adjustment

Our discussion of the pitfalls in using the price adjustment equation (16.1) does not imply that the equation is useless. In fact, such an equation is an integral part of the tool kit of practical economists and policymakers.

The graph shown in Figure 16.1 depicts the price adjustment process in a way useful for policy analysis. The inflation rate is on the vertical axis and real GDP measured as the deviation from potential GDP is on the horizontal axis. Because *lagged* real GDP (Y_{-1}) rather than current real GDP is on the right-hand side of Equation 16.1, the inflation rate does not depend on the current level of real GDP, which is on the horizontal axis. Hence, we represent Equation 16.1 as a flat line, labeled PA for price adjustment. According to Equation 16.1, the PA line will

1. shift up, indicating higher inflation, if real GDP was above potential GDP last year and shift down if real GDP was below potential GDP;
2. shift up if the expected rate of inflation π^e rises and shift down if the expected rate of inflation falls; and
3. shift up if there is a positive price shock (positive value of Z) and shift down if there is a negative price shock.

Note that Figure 16.1 has the inflation rate on the vertical axis, while the diagram we used in our earlier study of policy in Chapter 9 had the price level on the vertical axis. We now put the inflation rate on the vertical axis in order to consider monetary policies that focus on inflation rather than on the price level. These policies typically result in low but positive rates of inflation, such as the 2 to 3 percent inflation in the United States in the first half of the 1990s.

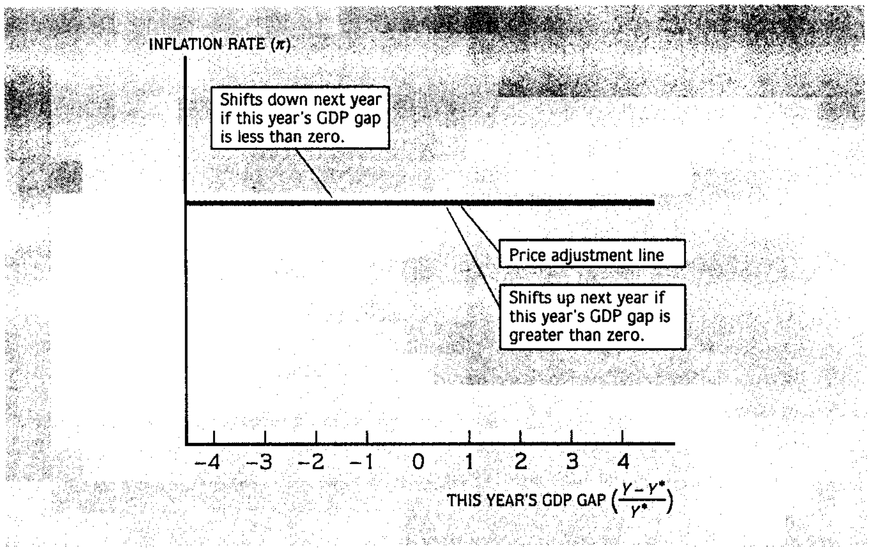

FIGURE 16.1 Price Adjustment Line Determining the Inflation Rate

In the price adjustment equation (16.1), the inflation rate is predetermined because it depends on the lagged GDP gap rather than on the current GDP gap. Hence, the price adjustment line is flat in a graph with inflation on the vertical axis and the current GDP gap on the horizontal axis. Because expected inflation responds to lagged inflation, the line shifts up (or down) gradually over time when the GDP gap is positive (or negative).

16.2

SUMMARIZING THE IS CURVE

In Chapter 7, we discussed and derived the IS curve. It is a downward-sloping curve showing all the combinations of GDP and the interest rate that correspond to spending balance. The economy always operates at a point on its IS curve, because the economy is always in spending balance. Monetary policy determines where the economy is on its IS curve. In this chapter, we need to state the IS curve in a somewhat different way than we did in earlier chapters.

Take a look at the algebraic IS curve in Equation 7.5, page 186, and also at the elaboration we introduced in Chapter 12, Equation 12.7, page 348, which brings the exchange rate into the picture. One of the factors we stressed in Chapters 10 through 13 is that spending depends on the real interest rate, $R - \pi$, rather than on the nominal interest rate, R. To capture this factor, and to use a simpler notation, we now write the IS curve as

$$R - \pi = s_0 - s_1 Y + s_2 G. \tag{16.3}$$

Here s_0 is the intercept of the IS curve, s_1 is the slope coefficient showing that the IS curve slopes downward, and s_2 shows the amount of the upward shift of the IS curve when government purchases rise. Now think about the economy at the point on the IS curve corresponding to full employment, where $Y = Y^*$. We define R^* as the real interest rate at the full-employment point and we call it the **equilibrium real interest rate.** It is

$$R^* = s_0 - s_1 Y^* + s_2 G. \tag{16.4}$$

Now we can subtract Equation 16.4 from Equation 16.3 to get a relationship between the difference between the actual real interest rate and the equilibrium real interest rate, on the one hand, and the gap between actual and potential output, on the other hand:

$$R - \pi - R^* = -s_1(Y - Y^*). \tag{16.5}$$

Notice how government purchases dropped out. Fiscal policy affects the real interest rate, but does not affect the difference between the actual real interest rate and the equilibrium real interest rate.

One last step: In our discussion of price adjustment, we have always measured the gap between actual and potential output in percentage terms, using the variable $(Y - Y^*)/Y^*$. We want our new version of the IS curve to use this variable too, so we rewrite equation 16.5 as

$$R - \pi - R^* = -(s_1 Y^*)\left(\frac{Y - Y^*}{Y^*}\right) \tag{16.6}$$

We let $\sigma = s_1 Y^*$; it is the slope of the IS curve, and we use the variable we defined earlier, $\hat{Y} = (Y - Y^*)/Y^*$, the percentage output gap. Then the IS curve is:

$$R - \pi - R^* = -\sigma\hat{Y}. \tag{16.7}$$

In words, there is a simple relation between the gap between the actual and equilibrium real interest rates and the gap between actual and potential output. The relation has a negative slope—if output is below potential, the real interest rate is above its equilibrium level. Thus, if the Fed wants to contract the economy and lower output, it needs to raise the real interest rate.

16.3

COMBINING PRICE ADJUSTMENT WITH AGGREGATE DEMAND

We now integrate the price adjustment equation into a model that describes monetary policy and traces its effect on aggregate demand. Because our analysis now focuses on the inflation rate rather than on the price level, we do not use the aggregate demand curve. Instead, we derive a new curve that relates aggregate demand to inflation. The starting point is the IS curve we just developed in the last section.

To incorporate monetary policy, we consider the case where the Fed sets the interest rate R. We assume that the Fed's monetary policy rule is the one we discussed in Chapter 14 (Equation 14.12):

$$R = \pi + \beta\hat{Y} + \delta(\pi - \pi^*) + R^f. \tag{16.8}$$

Here π^* is the Fed's target rate of inflation, and R^f is a coefficient.

Equations 16.1, 16.2, 16.7, and 16.8 form a model of economic fluctuations. The model is an extended version of the model we used for policy analysis in Chapter 9. In the new version, we can study the role of the monetary policy rule rather than focusing on onetime changes in the money supply. Because the policy rule has the Fed targeting inflation, we carry out the analysis in terms of the inflation rate rather than the price level.

Figure 16.1 showed Equations 16.1 and 16.2 as a price adjustment line. Figure 16.2 combines Equations 16.7 and 16.8. We call it the **aggregate demand–inflation curve.** It is a downward-sloping relation between inflation and the GDP gap, and it has the same role as the aggregate demand curve did when we were considering policies that focus on the price level, in Chapter 9. The curve shows that when inflation rises above target the Fed raises interest rates (according to the monetary policy rule, Equation 16.8) and this reduces the GDP gap (according to the IS curve, Equation 16.7). To derive the aggregate demand–inflation curve, we substitute Equation 16.8 into Equation 16.7. That is, we substitute

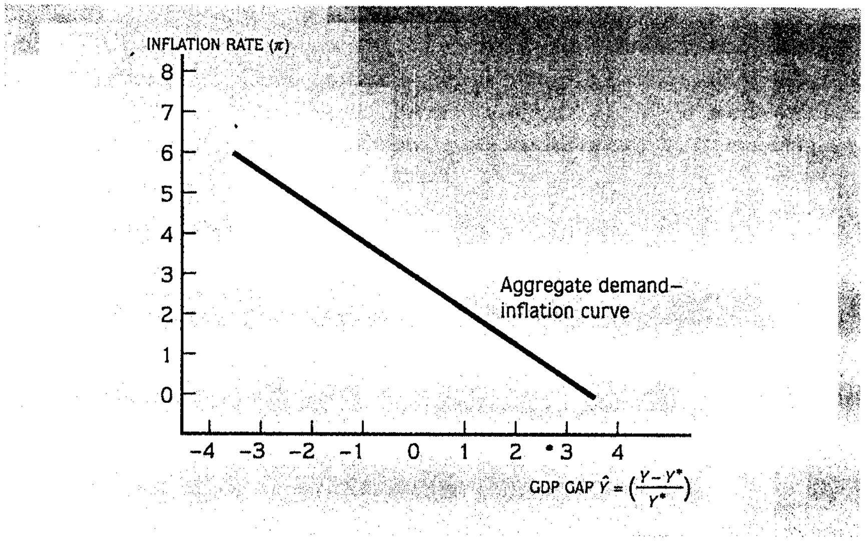

FIGURE 16.2 The Aggregate Demand–Inflation Curve

The curve shows a negative relationship between inflation and the GDP gap. When inflation increases, the Fed raises interest rates and this causes real GDP to fall; when inflation declines, the Fed lowers interest rates and this causes real GDP to rise; these are movements along the curve. Changes in the Fed's target rate of inflation or shocks to the IS curve cause the aggregate demand–inflation curve to shift. (See Equation 16.5.)

$$R - \pi - R^f = \beta\hat{Y} + \delta(\pi - \pi^*)$$

into

$$R - \pi - R^* = -\sigma\hat{Y}$$

to get

$$-\sigma\hat{Y} = \beta\hat{Y} + \delta(\pi - \pi^*) + (R^f - R^*)$$

or

$$\hat{Y} = -\frac{\delta}{\beta + \sigma}(\pi - \pi^*) - \frac{R^f - R^*}{\beta + \sigma} \qquad (16.9)$$

Equation 16.9 is the aggregate demand–inflation curve in algebraic form; it is a negative relation between the output gap, $\hat{Y}$, and the amount of inflation above target, $\pi - \pi^*$, as shown in Figure 16.2. On the upper left part of the curve, inflation is high and the Fed has contracted the economy; on the lower right, the situation is the opposite. From Equation 16.9, we see that the aggregate demand–inflation curve shifts to the right when the Fed changes its policy rule to a higher target rate of inflation, π^*.

Now we combine the price adjustment line of Figure 16.1 and the aggregate demand–inflation curve from Figure 16.2 in the same diagram, Figure 16.3. The intersection of the two curves gives the values of the GDP gap and inflation, $\hat{Y}$ and π. Figure 16.3 describes the operation of the model in a single picture. If there is a shift in either the price adjustment line or the aggregate demand–inflation curve, then the economy will move to a new combination of output and inflation, $\hat{Y}$ and π.

We use this approach to look at two examples, a boom and an oil price shock. In the examples we start the economy at full employment, with inflation equal to a target of 2 percent and then push the economy away from full employment with a shock.

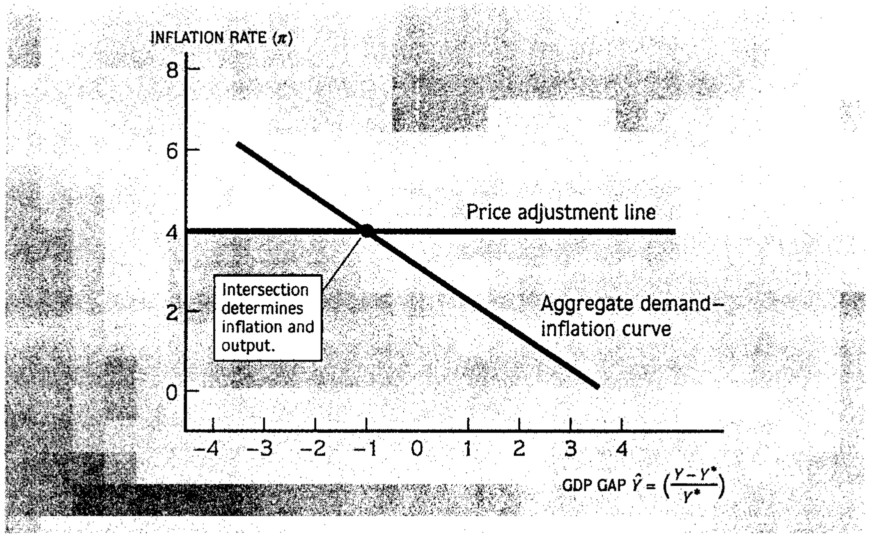

FIGURE 16.3 Simultaneously Determining Inflation and Output

The four-equation macro model (Equations 16.1 through 16.4) can be represented by these two curves. The solution of the model is found at the combination of inflation and output that is at the intersection of the two curves. When either of the curves shifts, the intersection changes and traces out patterns of inflation and the GDP gap.

Example 1: A Boom

What happens in the short, medium, and long runs when an outward shift in the aggregate demand–inflation curve sets off a boom? The outward shift could occur because the Fed adopted a higher inflation target or because of a shift in the IS curve, such as permanently higher government spending (note that equation 16.4 shows that a higher G raises R^*). At first, higher aggregate demand raises output. But higher output means inflation. In response to the higher inflation, the Fed raises interest rates and GDP falls. Eventually, the economy gets back to equilibrium, with output equal to potential and inflation at a higher level. In the new equilibrium, the only effect of the increase in aggregate demand is to raise the inflation rate. The path of the economy in response to an increase in aggregate demand is shown in Figure 16.4.

The path starts at equilibrium in year 1. There is 2 percent inflation and output is at potential. In year 2, the outward shift in aggregate demand raises output sharply. Because the inflation rate does not respond immediately, output increases by the full amount of the shift in aggregate demand. For the next few years, a series of increases in inflation depresses aggregate demand as the Fed acts to resist the inflation. Inflation gradually stops rising because output is less and less above potential. In the long run, output returns to its potential level and inflation settles at its new level.

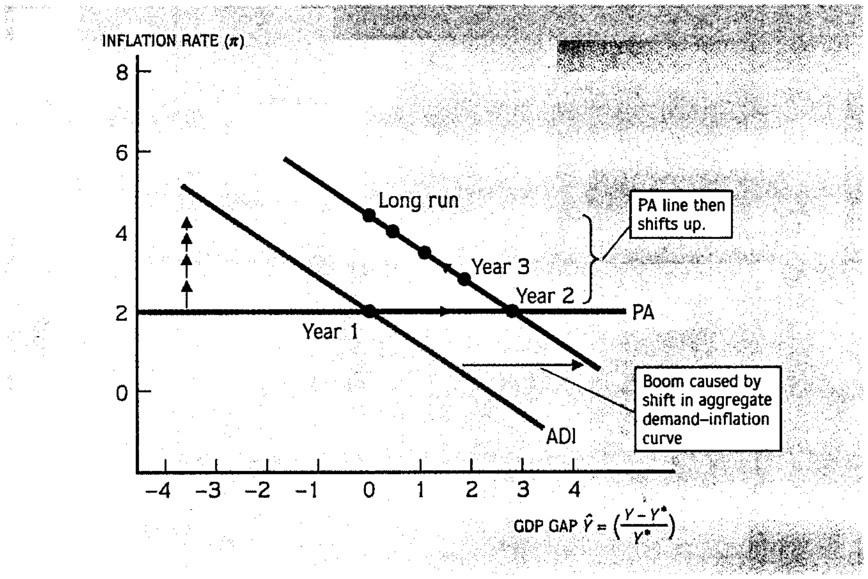

FIGURE 16.4 A Boom (Example 1)

The economy starts in equilibrium in year 1, with output equal to potential (zero GDP gap) and 2 percent inflation. In year 2 the aggregate demand–inflation curve shifts outward. Real GDP rises immediately. Inflation then worsens. As inflation rises, aggregate demand falls and output begins to recede toward equilibrium. The GDP gap returns to zero, but the inflation rate is permanently higher.

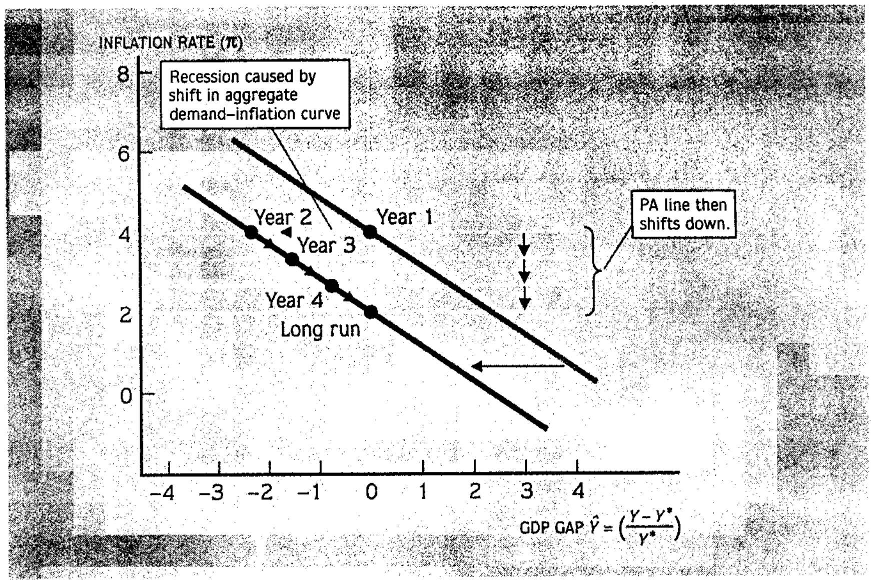

FIGURE 16.5 Disinflation (Example 2)

Here the Fed reduces the target rate of inflation from 4 percent to 2 percent. In the short run, real GDP declines below potential GDP and inflation does not change. Eventually inflation declines toward the new target of 2 percent and the economy returns to potential, with zero GDP gap.

If the original source of the boom was an outward shift of the IS curve—for example, from permanently higher government spending—the Fed will need to raise the constant R^f in its policy rule, Equation 16.8, in order to prevent the inflationary boom.

Example 2: Disinflation

Suppose now that the inflation rate is 4 percent, and the Fed decides that this is too high. Suppose that the Fed decides to reduce the target rate of inflation from 4 percent to 2 percent. In this case the aggregate demand–inflation curve shifts to the left, as shown in Figure 16.5.

At first, real GDP falls below potential GDP as the Fed raises the interest rate, but there is little change in inflation. Eventually, however, the rate of inflation falls, and as it does the Fed reduces the interest rate and the economy recovers gradually back to potential. Observe that this disinflation example has a path for inflation and output that is the mirror image of the boom in Example 1.

Examples 1 and 2 Combined: A Boom Followed by a Disinflation

It is useful to combine Examples 1 and 2 into a single scenario. First, suppose that the Fed starts on an expansionary monetary policy, as in Example 1, which shifts the aggregate demand–inflation curve to the right, starting a boom, but then leading to a higher inflation rate. Second, suppose the Fed decides that this new, higher inflation is too high and reverses itself by shifting back to a lower inflation target, as in Example 2; the aggregate demand–inflation curve now shifts to the left, starting a recession and eventually a lower inflation rate.

This combined scenario is shown in Figure 16.6, where we see a boom (real GDP above potential GDP) in the economy followed by a period slack (real GDP below potential GDP). During the boom, inflation is risin while during the slack period, inflation is falling.

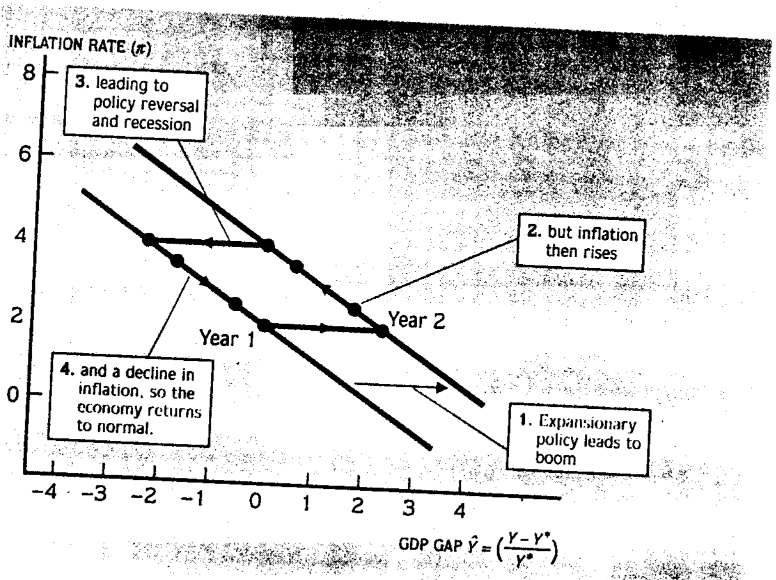

FIGURE 16.6 A Boom Followed by a Recession

First the aggregate demand–inflation curve shifts to the right, causing a boom and an eventual rise in inflation. Then the Fed decides it has let the inflation rate rise too much and engages in a disinflation; real GDP falls below potential in a recession, but eventually the inflation rate returns to the 2 percent target.

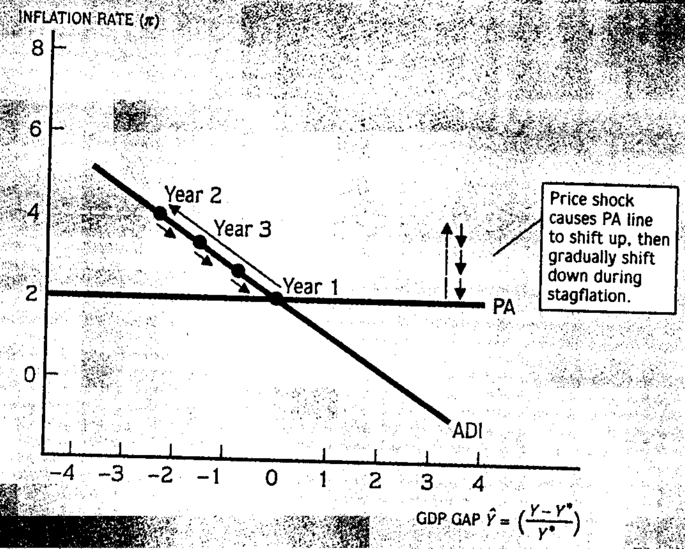

FIGURE 16.7 An Oil Price Shock (Example 3)

The economy starts at equilibrium in year 1. In year 2, inflation rises because of the higher oil price. In year 3, the GDP gap is negative because inflation is higher. Eventually a recovery takes place because inflation begins to fall. Output returns to potential, with zero GDP gap.

Example 3: An Oil Price Shock

In the 1970s and in 1990, the U.S. economy was battered by large and sudd increases in oil prices that sent the economy into periods of stagflation. W can trace out the reaction to a onetime price shock Z. Suppose Z increas in year 2 and then returns to zero for the indefinite future. The path of infl tion and output is shown in Figure 16.7.

In year 2, inflation jumps as a result of the oil price shock. High inflation causes the Fed to tighten, and this depresses output; the econom is in a state of stagflation. The recovery from stagflation proceeds as in Figu 16.5. As inflation subsides, aggregate demand begins to recover. The

The only effect of the price shock in the long run is a higher price level—there is no effect on real GDP or the rate of inflation.

4

EXPERIENCE WITH INFLATION AND OUTPUT IN THE UNITED STATES

How well does this model work as an explanation of the record of inflation and output fluctuations in modern economies? Before proceeding with policy analysis in the next chapter, it is important to check whether the theory is consistent with experience.

The inflation-output diagrams of the previous section (such as Figures 16.4, 16.5, and 16.6) provide a way for us to confront the theory with the facts. In the examples we considered, the model economy was displaced from its long-run potential. In each case the return path to potential displays a striking characteristic that is clear in the diagrams: The path (shown by the arrows in the figures) is counterclockwise because the economy tends to return to potential in a counterclockwise fashion. Note in particular how Figure 16.6 shows a complete counterclockwise loop.

Do inflation and output actually behave this way? Since real-world economies are constantly being shocked by many events, it is difficult to separate out isolated episodes like the special shocks in the model economy. Nevertheless, inflation and output fluctuations do display such counterclockwise loops. They are not so smooth as in the model economy, but they are there nonetheless.

In Figure 16.8 we show inflation and GDP gap pairs in the United States for each of the years from 1971 through 1995. Three loops are evident: one from 1971 through 1976, another from 1976 through 1986, and a third from 1987 to 1995. The first loop starts with the monetary-induced boom of 1971–73 and continues with the recession of 1975. The second loop occurred under very similar circumstances: a boom in 1977–78, followed by a subsequent large recession in the early 1980s. Note that the second loop started at a higher rate of inflation because expected inflation was high during that period. The third loop started from the lowest level of inflation in the boom of 1987–88 and had the smallest movement of GDP around potential, as the 1990–91 recession was relatively mild.

Overall, the model is consistent with the dynamic movements of inflation and output. While these graphical tests focusing on loops may appear overly simplistic, they are confirmed by more accurate statistical techniques, and we believe they capture the essence of the theory and the facts.

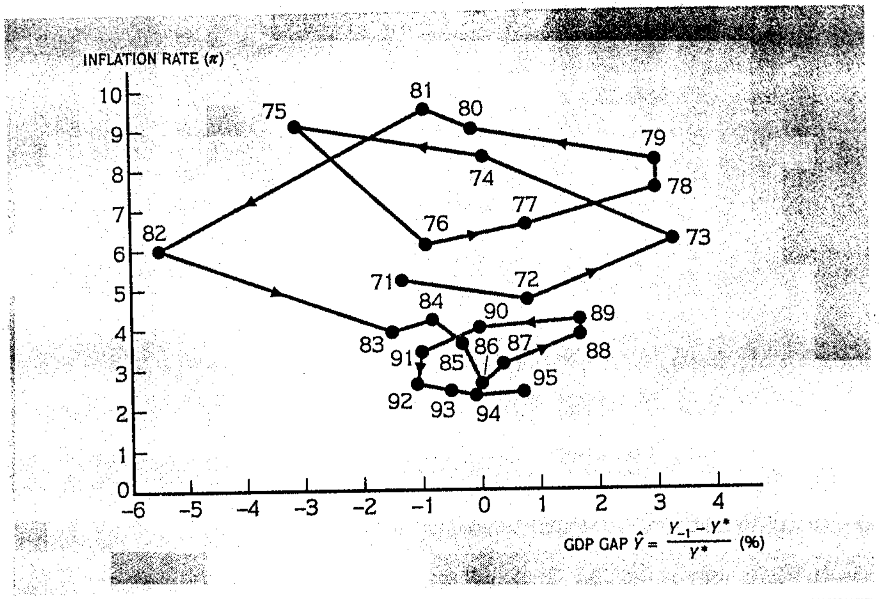

FIGURE 16.8 Inflation–GDP Gap Loops in the United States, 1971–95

During the 1971–95 period there were three big loops in the United States. The second loop started from a higher rate of inflation than the first and was the largest of the three.
Source: *Economic Report of the President*, 1996, Tables B-2 and B-3.

REVIEW AND PRACTICE

Major Points

1. A model of price adjustment must incorporate the response of inflation to excess demand and to expected inflation.
2. Expected inflation has forward-looking features and backward-looking features Expectations and contracts are both part of the micro underpinnings of the expected inflation term.
3. The model of price adjustment in this chapter is the same as in the model o Chapter 9 except that the coefficients of the model can change.
4. No simple mechanical formula is satisfactory as a model of expected inflation Any such model would be inconsistent with actual inflation behavior if policy o the economic environment changed.

5. In the long run, unemployment will equal the natural rate regardless of how high inflation is, as long as inflation is steady; this proposition is called the natural-rate property or the accelerationist property.
6. A model that combines aggregate demand with price adjustment implies that inflation and output will fluctuate or spiral as the economy returns to potential after a shock.
7. From the 1970s to the present the United States went through economic fluctuations that displayed such spirals of counterclockwise loops.

Key Terms and Concepts

accelerationist property
aggregate demand–inflation curve
expected inflation
indexing
stagflation
inflation–GDP gap loops
natural-rate property
oil price shock
wage-price spiral

Questions for Discussion and Review

1. What are the three elements included in the price adjustment equation?
2. How is expected inflation related to forward-looking behavior? To staggered wage-setting?
3. How can you determine potential output from the price adjustment equation?
4. Why does a one-year stimulus cause inflation to remain higher for many years?
5. Trace out the effects over time of an increase in materials prices, assuming that output is held constant.
6. What happens if policy tries to hold output above the natural rate for an extended period?
7. What are the four relationships that make up a model that shows how the economy fluctuates over time?
8. Explain why the economy approaches equilibrium in a loop in the inflation–real GDP diagram.

Problems

NUMERICAL

1. Example 1 of Section 16.3 looked at the inflation effects of a stimulus to output. In this problem we show how such effects vary with different models of inflationary expectations. Consider the following alternatives to Equation 16.2: (i) $\pi^e = .4\pi_{-1} + .2\pi_{-2}$; (ii) $\pi^e = .9\pi_{-1}$; (iii) $\pi^e = .5\pi_{-1} + .5\pi_{-2}$; (iv) $\pi^e = .33\pi_{-1} + .33\pi_{-2} + .33\pi_{-3}$. Assume $f = .25$ and $Z = 0$.
   a. For each of these expressions find the inflation effects of a permanent 3 percent stimulus to output ($\hat{Y} = .03$). Calculate the inflation rate for years 1 through 10.
   b. Estimate the long-run rate of inflation in each case.

The only effect of the price shock in the long run is a higher price level—there is no effect on real GDP or the rate of inflation.

4

EXPERIENCE WITH INFLATION AND OUTPUT IN THE UNITED STATES

How well does this model work as an explanation of the record of inflation and output fluctuations in modern economies? Before proceeding with policy analysis in the next chapter, it is important to check whether the theory is consistent with experience.

The inflation-output diagrams of the previous section (such as Figures 16.4, 16.5, and 16.6) provide a way for us to confront the theory with the facts. In the examples we considered, the model economy was displaced from its long-run potential. In each case the return path to potential displays a striking characteristic that is clear in the diagrams: The path (shown by the arrows in the figures) is counterclockwise because the economy tends to return to potential in a counterclockwise fashion. Note in particular how Figure 16.6 shows a complete counterclockwise loop.

Do inflation and output actually behave this way? Since real-world economies are constantly being shocked by many events, it is difficult to separate out isolated episodes like the special shocks in the model economy. Nevertheless, inflation and output fluctuations do display such counterclockwise loops. They are not so smooth as in the model economy, but they are there nonetheless.

In Figure 16.8 we show inflation and GDP gap pairs in the United States for each of the years from 1971 through 1995. Three loops are evident: one from 1971 through 1976, another from 1976 through 1986, and a third from 1987 to 1995. The first loop starts with the monetary-induced boom of 1971–73 and continues with the recession of 1975. The second loop occurred under very similar circumstances: a boom in 1977–78, followed by a subsequent large recession in the early 1980s. Note that the second loop started at a higher rate of inflation because expected inflation was high during that period. The third loop started from the lowest level of inflation in the boom of 1987–88 and had the smallest movement of GDP around potential, as the 1990–91 recession was relatively mild.

Overall, the model is consistent with the dynamic movements of inflation and output. While these graphical tests focusing on loops may appear overly simplistic, they are confirmed by more accurate statistical techniques, and we believe they capture the essence of the theory and the facts.

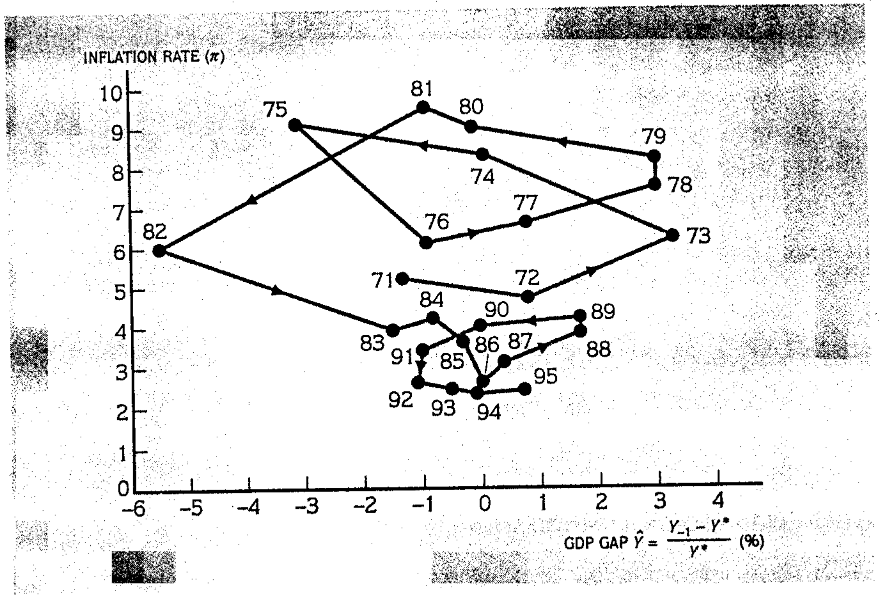

FIGURE 16.8 Inflation–GDP Gap Loops in the United States, 1971–95

During the 1971–95 period there were three big loops in the United States. The second loop started from a higher rate of inflation than the first and was the largest of the three.
Source: *Economic Report of the President*, 1996, Tables B-2 and B-3.

REVIEW AND PRACTICE

Major Points

1. A model of price adjustment must incorporate the response of inflation to excess demand and to expected inflation.
2. Expected inflation has forward-looking features and backward-looking features Expectations and contracts are both part of the micro underpinnings of the expected inflation term.
3. The model of price adjustment in this chapter is the same as in the model o Chapter 9 except that the coefficients of the model can change.
4. No simple mechanical formula is satisfactory as a model of expected inflation Any such model would be inconsistent with actual inflation behavior if policy o the economic environment changed.